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Nascar drivers safe due to lab development

by Pete Meltzer, Materials and Manufacturing Directorate

WRIGHT-PATTERSON AFB, OHIO — A high-performance polymer developed by scientists and engineers at the Materials and Manufacturing Directorate is being used to make super strength safety tethers that keep tires and wheels attached to race cars when they crash.

Polybenzobisoxazole (PBO) helps protect drivers and spectators from injury and even death from tires and wheels that have flown out of control in the past. At this year's Indianapolis 500, only one in five accidents resulted in a wheel breaking loose from a car, and in that instance, the new tether restraint system slowed its momentum enough to avoid any possible injuries.

Originally developed during the 1960s and 1970s for high-temperature aerospace applications such as flame-retardant flight suits and aircraft seat covers, PBO is part of a family of polymers known for their flame and abrasion resistance and outstanding tensile mechanical properties. Today, its being used in a wide variety of commercial products including tires, belts, heat- and flame-resistant clothing and ballistic flak jackets.

Following PBO's development, processing technology research continued for nearly 20 years before reproducible polymer products could be manufactured. Dow Chemical Company developed the commercial fiber production technology.

The tether system is built to handle accidents in excess of 200 mph. Each cable is similar in design to steel cables used to support large suspension bridges. The cables are comprised of about 10,000 individual PBO fibers, grouped in bundles, and intertwined to provide additional strength and stiffness. The cables are wrapped in a protective polyester sheath to keep them from unravelling.

"Some people may not recognize or be cognizant of the origin of the technology they so desire or marvel at," said Marilyn R. Unroe, a research chemist at Material and Manufacturing Directorate's Polymer Branch. "It just takes time and nurturing, sometimes 30 or 40 years, to see the outcome of the initial investments in government [research and development] with something so revolutionary and novel as high-performance polymer products."

Each PBO fiber is composed of high-strength filaments, so small they can only be seen under a microscope. Golden yellow in appearance, the PBO fiber is manufactured like yarn using a spinning process, and is passed through a small furnace on its way to a spool.

"PBO fiber can withstand temperatures up to 600 degrees C, the temperature found in the hotter areas of typical flames," Unroe said. "Unlike most fibers, however, it maintains its shape, mechanical properties and appearance at high temperatures, making it an exceptional candidate for heat-and flame-resistant products."

Possible military applications include its use as a ballistic jacket on the outside of pressure vessels, such as helium tanks on satellites, and for flak vests in body armor. In addition, the Federal Aviation Administration is currently examining PBO for use as a flame-resistant protective cloth between the cabin and the outer fuselage of aircraft to guard against engine shrapnel.

"Many people don't realize how the significant contributions of materials scientists relate to our progress as an advancing technology-driven civilization," Unroe said. "The materials and process technologies we are developing at ML and in other federal laboratory [research and development] programs are vital, not only to our Air Force and Department of Defense missions, but also to the improvements in our civilian lifestyles." **@**